

STUDIES ON FRESH-WATER BRYOZOA, XVII. MICHIGAN BRYOZOA

MARY D. ROGICK,
College of New Rochelle,
New Rochelle, N. Y.

AND

HENRY VAN DER SCHALIE,
University of Michigan,
Ann Arbor, Mich.

INTRODUCTION

The purpose of the present study is to record the occurrence of several bryozoan species from localities new to Michigan and other regions; to compile a list of the bryozoa previously recorded from Michigan; and to correct or revise the identification of some of the species collected long ago.

Records published by various writers from 1882 through 1949 have reported the following bryozoa from different Michigan localities, sometimes under synonyms or outmoded names:

Class ECTOPROCTA

Order GYMNOAEMATA

Family Paludicellidae

1. *Paludicella articulata* (Ehrenberg) 1831

ORDER PHYLACTOLAEMATA

Family Cristatellidae

2. *Cristatella mucedo* Cuvier 1798

Family Fredericellidae

3. *Fredericella sultana* (Blumenbach) 1779

Family Lophopodidae

4. *Pectinatella magnifica* Leidy 1851

Family Plumatellidae

5. *Hyalinella punctata* (Hancock) 1850
6. *Plumatella casmiana* Oka 1907
7. *Plumatella orbisperma* Kellicott 1882
8. *Plumatella repens* (Linnaeus) 1758
9. *Plumatella repens* var. *coralloides* (Allman) 1850
10. *Plumatella repens* var. *emarginata* (Allman) 1844
11. *Stolella indica* Annandale 1909

The recorded localities for the above list of bryozoa are named in Table I. The sixteen references from which the Table was compiled are on file with both authors and are not here reproduced.

To the above listed species the present study adds the following two new Michigan records:

Class ECTOPROCTA

Family Plumatellidae

- Plumatella repens* var. *jugalis* (Allman) 1850

Class ENTOPROCTA

Family Urnatellidae

- Urnatella gracilis* Leidy 1851

In addition to the *Urnatella gracilis* and the *Plumatella repens jugalis* three other bryozoa (*Paludicella articulata*, *Plumatella casmiana* and *Plumatella repens* var. *emarginata*) were found in new localities in the present study collections. Their distribution is given in Table II.

TABLE I

PREVIOUSLY RECORDED MICHIGAN COLLECTION SITES WITH ASSOCIATED COLLECTORS AND BRYOZOA

[illegible]

TABLE II
PRESENT STUDY COLLECTION SITES AND ASSOCIATED BRYOZOA

| State | Michigan Sites | | | | | Indiana | | Pennsyl- vania | Utah |
|---|----------------|-----|-----|-----|-----|---------|-----|-------------------|------|
| Station..... | 558 | 565 | 566 | 567 | 568 | 611 | 613 | 612 | 614 |
| <i>Urnatella gracilis</i> | | x | x | x | x | | x | | |
| <i>Paludicella articulata</i> | x | x | x | x | x | x | x | | |
| <i>Plumatella casmiana</i> | x | | | | | | x | | |
| <i>Plumatella repens</i> var. <i>jugal</i> is | x | | | | | | | | |
| <i>Plumatella repens</i> var. <i>emarginata</i> | x | | x | x | x | | x | x | x |

TABLE III
MEASUREMENTS OF PRESENT STUDY STATOBLASTS

| | <i>Plumatella casmiana</i> * | <i>Plumatella repens</i> var. <i>emarginata</i> |
|-------------------|------------------------------|---|
| Floatoblasts | | |
| a. Total length | 0.346-.360 mm. | 0.432 mm. |
| b. Total width | .216-.245 | .230 |
| c. Capsule length | .245-.266 | .281 |
| d. Capsule width | .187-.202 | .206 |
| e. Dorsal side | | |
| 1. Float length | .086 | .144 |
| 2. Float width | .043-.050 | .07 |
| f. Ventral side | | |
| 1. Float length | .058 | .115 |
| 2. Float width | .029-.036 | .022 |
| Sessoblasts | | |
| a. Total length | .461-.475 | .461-.468 |
| b. Total width | .360-.367 | .346-.389 |
| c. Capsule length | .410-.418 | .403 |
| d. Capsule width | .302-.317 | .288-.346 |
| e. Float width | .029 | .029-.036 |

*The *Plumatella casmiana* floatoblasts here measured are of the ordinary type which is shown in Figures 8 and 9 and not of the other type which is shown in Figures 10 and 11.

COLLECTION DATA

The material for the present study was collected within recent years from Michigan, Indiana, Pennsylvania and Utah. It consists of nine batches or samples of material numbered 558, 565, 566, 567, 568, 611, 612, 613 and 614. Strictly speaking, this study should have included only the Michigan samples #558, 565, 566, 567 and 568, but rather than prepare a separate paper for the other four samples from Indiana, Pennsylvania and Utah, it was decided to include them in the same paper with the Michigan specimens.

Sample #558 was collected by H. van der Schalie on July 18, 1945, in Lake Erie at Pte. Moullie, near the mouth of the Huron River, Monroe County, Michigan. It contained *Paludicella articulata*, *Plumatella casmiana* and scraps of *Plumatella repens jugalis*.

Sample #565 was collected by H. van der Schalie on September 6, 1945, near the railroad bridge one mile above Ionia, in Grand River, Ionia County, Michigan. It consisted of several empty mussel shells heavily encrusted with a thick mat of *Paludicella articulata*. Some showed germinated hibernacula, as well as stalks of *Urnatella gracilis*.

Sample #566 was collected by H. van der Schalie on September 4, 1945, from the Grand River, near Ionia, Ionia County, Michigan. It consisted of bivalves to which were adhering sessoblasts of *Plumatella repens emarginata*, old *Paludicella articulata* hibernacula and a few *Urnatella* stalks.

Sample #567 was collected by H. van der Schalie on September 5, 1945, from the Grand River below Lyons, Ionia County, Michigan. It consisted of bivalves on which were growing dense clumps of *Plumatella repens emarginata*, a few sprigs of *Urnatella* and *Paludicella articulata* colonies and hibernacula.

Sample #568 was collected by H. van der Schalie on September 6, 1945, from Grand River below the Dexter Street Bridge at Ionia, Michigan. It consisted on bivalves overgrown with *Paludicella* colonies and hibernacula, *Urnatella* stalks and some *Plumatella repens emarginata* statoblasts.

Sample #611 was collected by H. van der Schalie on August 31, 1948, at Station 11 in Pigeon Creek just east of Flint, Jackson Township, Steuben County, Indiana. It consisted of mussel shells, tiny rock fragments, pieces of broken glass and other debris, moderately covered with *Paludicella articulata* colonies and hibernacula.

Sample #612 was collected by H. van der Schalie and Harold W. Harry on August 27, 1948, at Station 4 in Traverse Creek, a western branch of Racoon Creek, west of Clinton, Pennsylvania, near U. S. Highway #30. It consisted of rock and mussel scrapings and some *Plumatella repens emarginata* statoblasts.

Sample #613 was collected by Carl D. Riggs on August 7, 1946, from Tippecanoe River, seven miles below Pulaski, Pulaski County, Indiana. It consisted of mussel shells encrusted with *Urnatella gracilis*, *Paludicella articulata* and *Plumatella casmiana*.

Sample #614 was collected by H. van der Schalie and Elmer G. Berry on June 16, 1934, from Nibley Park Stream at Salt Lake City, Utah, and contained *Plumatella repens emarginata* scrapings.

The five bryozoan species from the above samples are listed in Table II and are discussed in more detail in the following section.

DISCUSSION

Urnatella gracilis

Urnatella gracilis is a colonial form consisting of one to six beaded or segmented stalks arising from a basal plate. The stalks are tipped by a calyx or head and may have additional short branches and calyces arising from the main beaded stalk. Sometimes there is a cluster of such small branches near the distal tip of the stalk. Other times there are sparse branches arising from several regions along

the stalk. Bracket or handle-like structures on the stalk indicate the bases of broken off branches (see Fig. 16).

The number of segments in the stalk varies from one to eighteen. Those nearest the basal plate are conspicuously urn-shaped (see Fig. 14); those more distal are more bead-like, softer in texture and lighter or paler in color. The basal segments are usually deeply colored (amber, brown or black), depending upon age. The deepest coloration is in the constricted region of each segment. A dark perforated septum incompletely separates successive segments. Davenport (1893, p. 7) found the top septum which separates the calyx from the stalk to be somewhat more complex than the other septa. He also reported seeing flame cells and yolk granules in the stalk.

Each stalk terminates in a calyx. These calyces or heads may drop off and new ones may regenerate from the stalk tip, apparently as in *Barentsia laxa* and related species. The calyx is rimmed by 8 to 16 tentacles which are not retractile but roll inward, as in other Entoprocts (see Rogick, 1948, *Barentsia laxa* figures, especially Figs. 15, 17, 19, 20, 22, 24 and 33). The internal anatomy of the calyx, as described in Davenport's 1893 paper, appears to be similar to that of *Barentsia laxa*. Davenport (p. 15) was able to find only adult male zoids so could not study the sexual reproduction of *Urnatella* or the anatomy of female specimens, so that is one of the problems remaining for some future worker.

Richardson (1921, p. 442) reported *Urnatella* as feeding on diatoms.

The present specimens were collected in Grand River, Ionia County, Michigan, and in Tippecanoe River near Pulaski, Indiana, see Table II.

The known distribution records for this as yet exclusively American bryozoan are as follows: Leidy found *Urnatella gracilis* on a number of occasions between 1851 (p. 322) and 1884 (pp. 5-6) around Philadelphia, in the Schuylkill River, below Fairmount dam, on the underside of stones, shells, on eel grass *Vallisneria spiralis* and on water star grass *Schollera graminea*. His friend, Dr. Isaac Lea, showed him a *Unio* shell from the Scioto River in Ohio on which were some *Urnatella* remains. Davenport (1893, p. 2) and Potts in 1892 collected *Urnatella* in great quantities from the turbulent waters immediately below the overflow of

EXPLANATION OF PLATE I

All figures were drawn from preserved material with the aid of a camera lucida.

FIG. 1. An old *Plumatella repens* var. *emarginata* sessoblast. The free surface of its large dark capsule is roughened by slightly raised ridges. Drawn to Scale A.

FIG. 2. A younger *Plumatella repens* var. *emarginata* sessoblast. Dissected out of the same colony as floatoblasts on Figures 3 and 4. Drawn to Scale A.

FIG. 3. The dorsal surface of a *Plumatella repens* var. *emarginata* floatoblast, showing the dark capsule about half covered by the float. Drawn to Scale A.

FIG. 4. The ventral surface of a *Plumatella repens* var. *emarginata* floatoblast showing the lesser encroachment of the float upon the capsule. Drawn to Scale A.

FIG. 5. Edge view of *Plumatella repens* var. *emarginata* floatoblast, showing the flat dorsal face and curved ventral face. The statoblast is resting on its dorsal face in this figure. Drawn to Scale A.

FIG. 6. A sessoblast of *Plumatella casmiana*. It closely resembles those of *P. repens* var. *emarginata*. Drawn to Scale A.

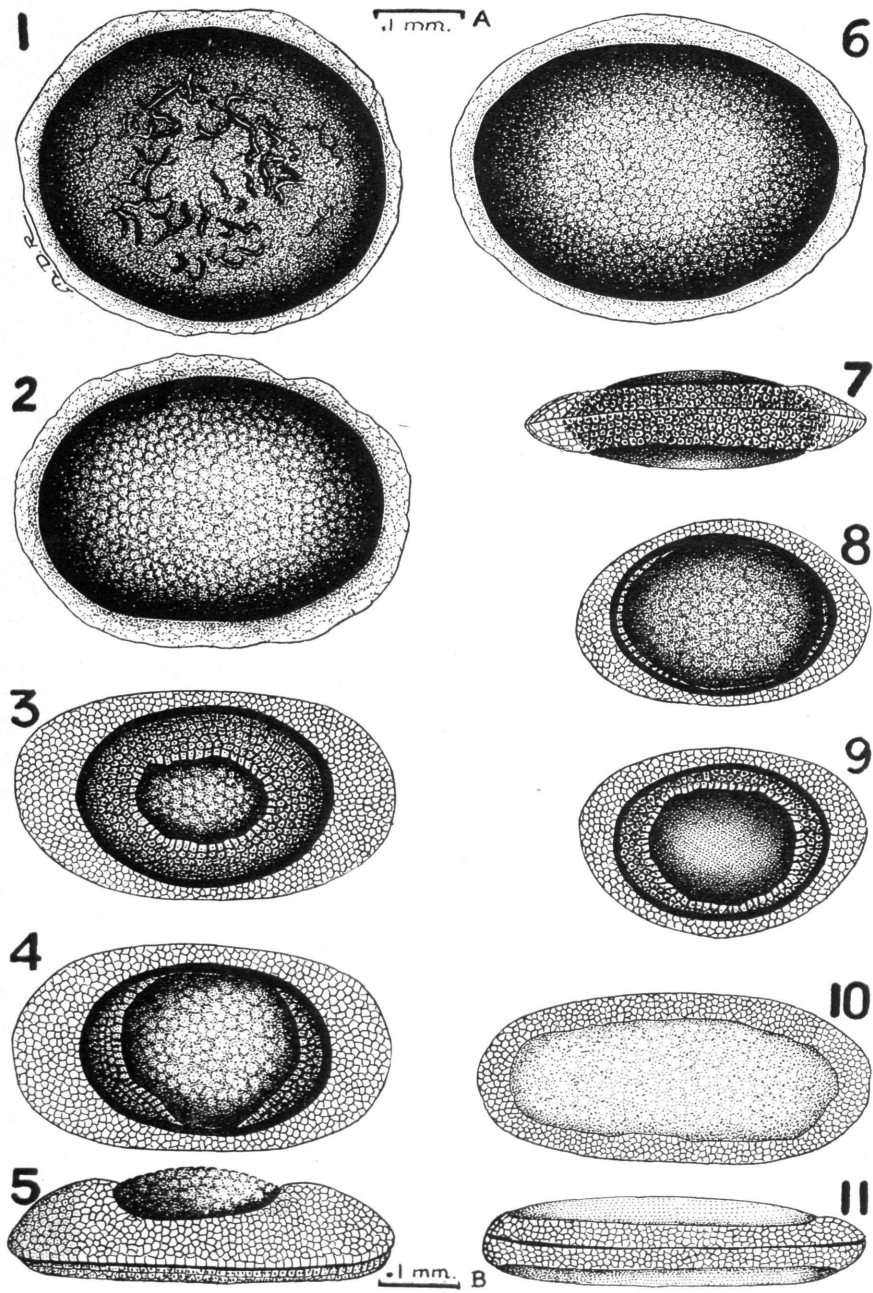
FIG. 7. Edge view of one type of *Plumatella casmiana* floatoblast. Adapted from Study XIII, p. 267, Fig. 7 (Rogick, 1943).

FIG. 8. Ventral face of a *Plumatella casmiana* floatoblast of the same type as the preceding. Drawn to Scale A.

FIG. 9. The dorsal face of a *Plumatella casmiana* floatoblast of the same type as the preceding. Drawn to Scale A.

FIG. 10. Face view of the second, distinctive, thin-walled type of floatoblast of *Plumatella casmiana*. Drawn to Scale B.

FIG. 11. Edge view of the same type of *Plumatella casmiana* floatoblast as the preceding. Drawn to Scale B. Adapted from Study X, p. 213, Fig. 3 (Rogick, 1941).



the Flat Rock Dam in the Schuylkill Canal near Shawmont Station, Pennsylvania. It covered almost every stone. Kofoed (1898, p. 402) found *Urnatella* at Havana, in the Illinois River near the Illinois Biological Station and in 1908 (p. 290) in the channel bottom of the river on Unionidae shells. Hempel (1899, p. 341) also found it in the Illinois River, from bottom towings. Richardson, between 1921 and 1928, reported the species from several localities along the Illinois River, namely: at Havana (1921, p. 440); in Peoria Lake below Chillicothe (1924, p. 380); at McKinley Bridge and Pekin, Illinois, in a strong current (1925, p. 417); and from LaSalle to Beardstown (1928, pp. 391, 407). Williams (1930, p. 280) reported *Urnatella* from Licking River in Kentucky. Rogick (1935, p. 258) found *Urnatella* in a number of Lake Erie, Ohio, localities. Several years ago specimens from Clinton River, Michigan, were sent to the senior author by Dr. C. J. D. Brown. *Urnatella* has been observed in Lake Dallas, Texas, by Dr. B. B. Harris and in the Mississippi River near Fairport, Iowa, by Dr. R. C. Osburn.

Paludicella articulata

Paludicella articulata is a dainty yellow to brownish form growing in fine traceries on all types of submerged materials (shells, rocks, etc.). It is closely adherent but when its branching is luxuriant and the substratum limited in area it forms a soft, loosely felted mat. Instead of forming statoblasts as do most freshwater bryozoa, *Paludicella* produces germinative bodies or "winter buds" called hibernacula (see Figs. 13, 15, 17, 18). These hibernacula are generally darker and much more opaque than the ordinary zoids. They are usually irregular in shape and split apart on germination but not so regularly as do statoblasts. The zoids are long, slender, spindle-shaped and linearly arranged. One or two zoids may sprout at an angle from the sides of each zoid (see Fig. 19). The zoids have a projecting, squared orifice. The tentacles number 16 to 18.

Paludicella articulata has a very wide distribution. In the present material it was found in abundance in the Michigan and Indiana samples (see Table II). It has previously been reported from a number of U. S. A. localities by Davenport, Richardson, Rogick and Ward. It has been reported by various writers from Belgium, Canada, China, England, Esthonia, Finland, France, Germany, Greenland, Hungary, India, Ireland, Italy, New Zealand, Norway, Russia, Scotland, Siberia and Switzerland.

Plumatella casmiana

There was some question as to whether this form should be called *Plumatella casmiana* or *Plumatella repens* var. *casmiana*. Dr. Toriumi, in his excellent 1942b

EXPLANATION OF PLATE II

FIG. 12. Sprig of a dead *Plumatella casmiana* zoarium showing somewhat angular, distinctly keeled zoids. Drawn to Scale C.

FIG. 13. Fragment of a pale-colored empty *Paludicella articulata* zoid from which the dark irregular hibernaculum had originated. Drawn to Scale B.

FIG. 14. Two *Urnatella gracilis* stalks attached to the same basal plate. Because this was preserved material some of the more distal segments are slightly collapsed and the calyces are missing. Drawn to Scale B.

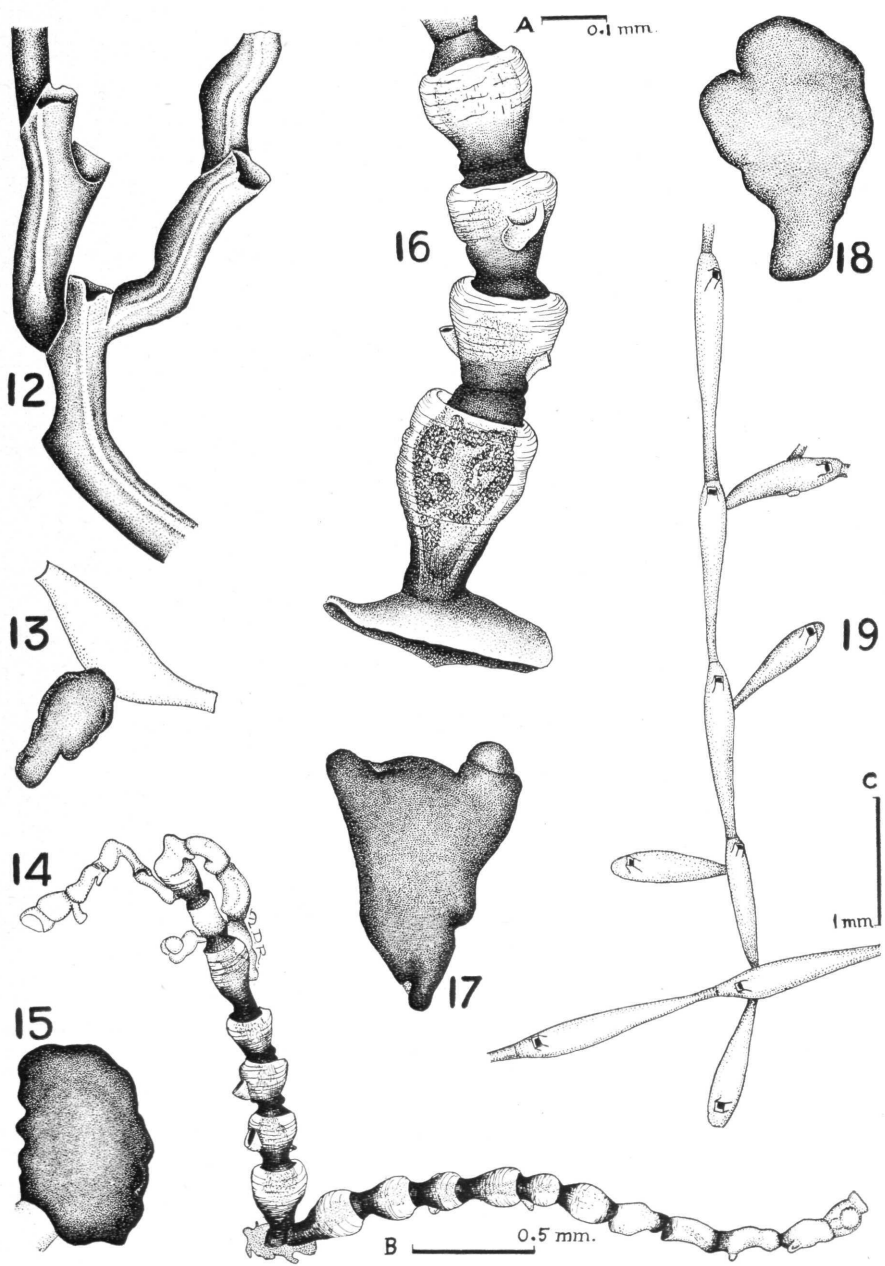
FIG. 15. A differently shaped hibernaculum of *Paludicella articulata*. Drawn to Scale A.

FIG. 16. A more detailed view of the basal plate and four lower segments of an *Urnatella gracilis* stalk. The brackets on the two middle segments represent broken off buds. Note the urn shape of the segments. Drawn to Scale A.

FIG. 17. Another differently shaped *Paludicella articulata* hibernaculum. Drawn to Scale A.

FIG. 18. Still another hibernaculum of *Paludicella*, drawn to Scale A.

FIG. 19. Portion of a *Paludicella articulata* colony showing the regular mode of branching (lateral and terminal). Drawn to Scale C.



paper (p. 209), prefers the latter classification because the forms of the colony and two types of statoblasts are so much like those of *Plumatella repens* var. *emarginata*. The present writers prefer the other classification (*P. casmiana*) because of the presence of the third type of statoblast (Figs. 10, 11). Should this peculiar, transparent, thin-walled type be found in other *Plumatella repens* varieties then *P. casmiana* unquestionably would be listed as a variety of *P. repens*.

Both Toriumi (1942b) and Rogick (1941, 1943) pictured the zoarium and two distinct types of floating statoblasts (floatoblasts). The present paper shows the third type of statoblast (sessoblast). By itself the *P. casmiana* sessoblast seems indistinguishable from that of *P. repens emarginata*. Measurements for two ordinary (capsuled, as in Figs. 8 and 9) floatoblasts are given in Table III. The zoarium or colony and the sessoblasts of *P. casmiana* and *P. repens emarginata* are very similar. The floatoblasts of *emarginata* when seen in edge view are flatter on the dorsal than on the ventral side and the dorsal side of the capsule is much more covered by the float than in *P. casmiana*. Compare Figs. 3, 4, 5 and 7, 8, 9.

Plumatella casmiana occurred in samples #558 and #613, from Michigan and Indiana, respectively. Kenk (1949, pp. 34, 57) reported this species from a pond in southern Michigan and Rogick (1941, 1943) from Lake Erie (Ohio and Canada). Foreign localities from which it has been reported are Formosa, Japan, U. S. S. R. and West Java.

Plumatella repens* var. *emarginata

The *P. repens emarginata* zoarium and sessoblasts are similar in appearance to those of *P. casmiana*. The zoarium is closely adherent, encrusting, tan to dark brown in color. The zoids are noticeably keeled. The floatoblasts are elliptical, slightly flatter on the dorsal side than on the ventral (see Fig. 5). The dorsal side float covers more of the capsule than does the ventral side float (see Figs. 3, 4). Measurements of several typical statoblasts are given in Table III.

This variety occurred in a number of Michigan, Indiana, Pennsylvania and Utah samples as listed in Tables I and II. It is widely distributed over the U. S. A. and elsewhere in the world and has been reported by many workers. Some of its interesting distribution records in foreign localities are: Africa; Asia (India, Java, Sumatra, Malay Peninsula); Europe (Belgium, Czechoslovakia, England, France, Germany, Hungary, Ireland, Italy and Russia).

Plumatella repens* var. *jugalis

The confused status of the geminate *jugalis* form was discussed in an earlier study (Rogick 1941, pp. 214-219). Very likely it is not a distinct variety but the growth form of one of the other *P. repens* varieties. Since the problem of its taxonomic status has not been solved the above unsatisfactory classification must be used.

This form has been reported only a few times since its discovery in Essex, England, by Allman in 1850. The present specimens were few in number and came from sample #558 (Michigan). The other North American (Ohio and Canada) collection sites for this form are in Lake Erie (Rogick 1935, pp. 253-254). There it occurred in considerable abundance.

Plumatella orbisperma

This species has been recorded only once in literature—in 1882, by Kellicott, from a pond on the border of Little Traverse Bay, Michigan. Unfortunately, it was incompletely described by Kellicott (1882, pp. 227-228). Only its nearly circular or orbicular statoblast was pictured. The statoblast measured about .325 mm. x .360 mm., with both sides nearly equally convex. The ectocyst was

described as colorless but not so thick as in *Hyalinella punctata*. The tentacle number was given as about 60. The description of the colony is inadequate so one can not really be sure to what genus this form belongs. Its floatoblasts very closely resemble in measurement and general appearance those of *Stephanella hina* which to date has been recorded only from Japan by Oka (1908) and Toriumi (1942a). However, *Stephanella hina* is described as having fewer tentacles (36-40), and has a sizeable ectocyst. The present writers have not found Kellicott's species but it would be an excellent idea for any collector who finds this form in the future to make a more detailed study of the species, particularly of the zoid anatomy and the zoarium growth habit.

SUMMARY

1. Five bryozoan species were found in nine collection samples. Of these nine samples five were from new Michigan localities, two were from Indiana, one from Pennsylvania and one from Utah.

2. A revision of identification and compilation of a list of previously reported Michigan Bryozoa is included. To date 11 species and varieties have been recorded from Michigan. The present study adds two more to the Michigan list: *Urnatella gracilis* and *Plumatella repens jugalis*.

3. *Paludicella articulata* was the most abundant bryozoan occurring in the Michigan and Indiana collections.

4. *Urnatella gracilis* was the next most abundant in the Michigan and Indiana collections.

5. *Plumatella repens emarginata* was the third most abundant form and occurred in the Michigan, Indiana, Pennsylvania and Utah samples.

6. *Plumatella casmiana* occurred in a Michigan and Indiana collection and was not especially abundant.

7. *Plumatella repens jugalis* occurred in very small quantity in one Michigan collection.

8. A *Plumatella casmiana* sessoblast is pictured for the first time but is indistinguishable from that of *P. repens emarginata*.

9. *Plumatella orbisperma* Kellicott 1882 is briefly discussed.

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